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Technical Efficiency of Turmeric (*Curcuma Longa L.*) Production in Benue State, Nigeria

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ABSTRACT

Purpose: The study analyzed the technical efficiency of turmeric production in Benue State, Nigeria. Taro Yamane's formula was used to select 28 respondents.

Methodology: The research made use of experimental design and a multistage, purposive and proportionate sampling was used for the study. Data for the study were collected with the aid of structured questionnaire from 28 turmeric farmers in Konshisha, Vandeikya, and Gwer-East Local Government Areas of Benue State. The collected data were analyzed using descriptive statistics and stochastic frontier production function.

Findings: Analysis of the result showed that majority (53.6%) of the turmeric farmers had technical efficiency level between 31% and 60%. Also, analysis of the stochastic frontier production function revealed that age, sex, farm experience, and household size of turmeric farmers in the state significantly influenced their technical efficiency.

Recommendations: It was recommended that policies aimed at increasing the resource use efficiency of turmeric farmers in the State and hence their farm output can be increased by providing the turmeric farming communities with improved planting ,harvesting, peeling and drying machines for higher efficiency.

Keywords: *Turmeric, Technical Efficiency, Production, Stochastic Production Function, Benue State, Nigeria.*

INTRODUCTION

Turmeric (*Curcuma Longa L*.) is a commercial spice crop whose benefits abound. Potentials of turmeric in terms of health value, economic imperatives have been unveiled locally and globally. The crop has widely been used as food additive, condiment, and medicine (Amadi *et al*., 2018). However, in spite of the vast benefits of turmeric in terms of its derived products in Nigeria, the demand-supply gap for this crop has continued to increase as the crop is grown mainly in small plots around homes and can also be found in the wild (Chukwudi *et al*., 2019). Increase in turmeric production is possible mainly through improvement in productivity of the crop which could be realized via efficient utilization of available scarce resources. In this context, assessment of the technical efficiency in the production of turmeric assumes paramount importance.

Hence, the study was conducted with the overall objective of analyzing the technical efficiency of turmeric production in Benue State, Nigeria, with the following specific objectives:

i. Determine the technical efficiency level of small-scale turmeric producers in the study area; and
ii. Estimate the determinants of technical inefficiency among small scale turmeric producers in the study area.

METHODOLOGY

The Study Area: The study was conducted in Benue State, Nigeria. The State has 23 Local Government Areas, and its Headquarters is Makurdi. Located between Longitudes 6^0 35'E and 10^0E and between Latitudes 6^0 30'N and 8^0 10'N. The State has abundant land estimated to be 5.09 million hectares which represents 5.4 percent of the national land mass. Arable land in the State is estimated to be 3.8 million hectares (WARDROP, 1993; BENKAD, 1998). The State is predominantly rural with an estimated 75 percent of the population engaged in rain-fed subsistence agriculture. Benue State which is popularly known as the "Food Basket" of the Nation, the State shares common boundaries with Nassarawa in the North, Cross Rivers in the South, Kogi and Ebonyi States in the West and Taraba State in the East.

Benue State has an estimated population figure of 4,219,244 inhabitants (National Population Commission, NPC, 2007). However the Projection of 3.0% annual population change puts the population of the State currently at 5,741,800. The State has vast smallholder farmers who are into production of roots and tubers like yams, cassava, cocoyam, ginger and turmeric; oil seed crops like pigeon pea, soybeans and groundnuts; and tree crops like citrus, mango, oil palm, guava, and cashew. Benue State is located within the Southern Guinea Savannah and has distinct wet and dry seasons. The wet season is from April to November and the dry season is from December to March.

Sampling Technique and Data Collection: The multi-stage sampling technique was employed to select a sample size of 28 turmeric farmers. In the first stage, three Local Government Areas namely Konshisha, Vandeikya, and Gwer-East were purposively selected due to the intensity of turmeric activities in them. The second stage involved the random selection of turmeric producing farm households.

The data for the study were collected with the aid of a well-structured questionnaire. The questionnaire was designed to provide answers on the socio-economic characteristics of turmeric producers, the quantity and cost of inputs used, as well as their farm output. Due to the low level

of literacy among the farmers in the study area, trained enumerators were sourced among the extension staff of the Agricultural Development Project (ADP) in the State, to administer the questionnaire to the farmers.

Analytical Technique: The collected data were analyzed using descriptive and stochastic production function. Objective (i) was achieved using descriptive statistics such as frequency table, percentage, and mean; objective (ii) was achieved using stochastic production function.

Stochastic frontier model

In order to achieve objective ii, Cobb-Douglas production frontier function was estimated using the Maximum Likelihood Techniques. From the production frontier, the corresponding dual cost frontier was determined. These two frontiers are the basis for deriving farm level efficiency measures. The stochastic production frontier was written as:

$\ln Y_i = \ln\beta_0 + \beta_j \ln X_{ij} + V_i - U_i$ ……. (1)

Where:

ln = the natural logarithm

Y_i = Farm output (kg)

X_{ij} = Vector of farm inputs (X1 – X5) used

X_1 = Farm Size (hectares)

X_2 = Quantity of seeds (kg)

X_3 = Fertilizer (kg)

X_4 = Total Labour used (man hours) and

v = random variability in the production that cannot be influenced by the farmer;

μ = deviation from maximum potential output attributable to technical inefficiency.

β_o = intercept;

βi= vector of production function parameters to be estimated;

i = 1, 2, 3, n farms;

j = 1, 2, 3, m inputs.

***A priori* expectation** was that $b_1, b_2, b_3, b_4 > 0$ while $b_5 < 0$

The inefficiency model was used to achieve objective (ii). It was specified as:

$\mu_i = \delta_o + \delta_1 Z_1 + \delta_2 Z_2 + \delta_3 Z_3 + \delta_4 Z_4 + \delta_5 Z_5 + \delta_6 Z_6 + \delta_6 Z_6 + \delta_6 Z_6 + \delta_7 Z_7$ …….. (2)

Where,

u_i= technical inefficiency effect of the ith farm;

Z_1 = age of farmer in years;

Z_2 = sex (single 1, other =0)

Z_3= marital status (married 1, other 0)

Z_4= educational level of farmer in years of formal education completed;

Z_5 = major occupation (farming =1, other 0)

Z_6 = household size (no.);

Z_7 = membership of cooperative society (member=1, non-member=0)

δ_0 = constant

$\delta_1 - \delta_6$ = parameters to be estimated.

These socio-economic characteristics are included in the model to investigate their influences on the technical efficiency of resources employed by participating entrepreneurs. The ß and δ coefficients are un-known parameters to be estimated along with the variance parameters δ2 and γ. Aigner*et al.* (1977), Jondrow*et al.* (1982), and Green (1993) defined δ2 and λ as:

$\delta_2 = \delta_2 v + \delta_2 u$ and $\lambda = \delta u / \delta v$

Battese and Corra (1977) defined γ as total variation of actual output towards its frontier such that $\gamma = \delta_2 u / \delta_2$

Consequently, $0 < \gamma < 1$ and one may obtain the estimated value of γ

The δ_2, and γ, coefficients are the diagnostic statistics that indicate the relevance of the use of the stochastic production frontier function and the correctness of the assumptions made on the distribution form of the error term. The δ_2 indicates the goodness of fit and the correctness of the distributional form assumed for the composite error term. The γ, indicates that the systematic influences that are unexplained by the production function are the dominant sources of random errors.

In the context of the stochastic frontier production function, the technical efficiency of an individual farmers is defined as the ratio of the observed output to the corresponding frontier output, conditional on the levels of inputs used by the farmers. Thus, the technical efficiency of farmers i is: TEi = exp (-μi), that is

$$TE_i = Y_i / Y_i^* = f(X_i; \beta) \exp(v_i - \mu_i) / f(X_i; \beta) \exp(V_i) \exp(-U_i) \quad \ldots\ldots (3)$$

Where

TE_i = Technical efficiency of farmer i; Y_i = observed output and; Y_i^* = frontier output. The technical efficiency of a farmer ranges from 0 to 1. Maximum efficiency in production has a value of 1.0. Lower values represent less than maximum efficiency in production.

V_i = is independently and identically distributed random errors, having N (0, σ^2) distribution.

U_i= allocative inefficiency

Technical inefficiency= 1- TE_i.

RESULTS AND DISCUSSION

TECHNICAL EFFICIENCY ESTIMATES OF TURMERIC FARMERS IN BENUE STATE

The technical efficiency estimates summarized in Table 1 indicate that small-scale turmeric farmers in Benue State had technical efficiencies varying from10 to 81 percent with a mean of 49 percent.

Table 1: Distribution of Respondents by Technical Efficiency in Benue State

Technical Efficiency	Frequency	Percentage (%)
<=0.30	5	17.9
0.31-0.60	15	53.6
0.61-0.90	8	28.5
Total	28	100
Maximum	0.81	
Minimum	0.01	
Mean	0.49	

Source: Field Survey, 2020

The wide range to values indicates large variations in performance across turmeric farms. This implies that turmeric farmers in the study area were not utilizing their production resources efficiently, the results suggests that most of the turmeric farmers in the study area had not yet reached the production frontier, indicating that they were not obtaining maximum output possible from their given quantum of scarce inputs. In words, technical efficiency among the respondents could be increased by 51 percent in the study area through better use of improved agronomic practices, use of available production resources, and given the current state of technology.

The implication of the foregoing result is that if the average turmeric farmers in the sample were to achieve technical efficiency level of his or her most efficient counterpart, he or she would realize 32 percent more productivity. This suggest that the scope for efficiency gain is large (percentage increase in mean efficiency = [1-(mean efficiency/maximum efficiency]) 100). Technical efficiency in turmeric farming in the study area could be increased by up to 51 percent on average, using the current production technology.

This implies that turmeric productivity in the study area could be greatly enhanced using current production technology, if key factors that currently constrain production efficiency are adequately addressed. Specifically, 17.9 percent of small-scale turmeric farmers had technical efficiency of <=0.30, 53.6 percent had technical efficiency from 0.31-0.60 and 28.5 percent of turmeric farmer had technical efficiency estimate ranging from 0.61-0.90. None of the respondents could attain the frontier efficiency of 1.The most efficient farmer had efficiency of 81 percent.

DETERMINANT OF TECHNICAL INEFFICIENT OF SMALL-SCALE TURMERIC PRODUCTION IN BENUE STATE

Result of analysis of the diagnostic statistics presented in Table 2 indicated that there was technical inefficiency effect in turmeric production in Benue State. This was confirmed by the significant value of gamma (ɤ) coefficient. A gamma (ɤ) value of 0.97 indicates that 97% of the variation in the output of turmeric production in Benue State by the respondents was attributed to technical inefficiency effect alone, while 3% was due to random effect. In addition, the generalized likelihood ratio was also significant at 1% level, suggesting the presence of one sided error component. This means that inefficiency factors were significant in the stochastic frontier model. Also shown in Table 2, the estimated sigma square (σ^2) was significant at 10% level of probability indicating goodness of fit and correctness of the specified distribution assumption of the composite error terms.

The estimated coefficient of the technical inefficiency effects model indicated that age, education, household size and membership of organization had positive significant influence on technical inefficiency of turmeric production in Benue State, while sex, farm experience reduced significantly the effect of technical inefficiency of small-scale turmeric farmers in the study area. The coefficients of sex and farm experience were negative and significant at 10% level of probability. The implication is that technical inefficiency effects in small-scale turmeric production in the study area declined with increase in these variables.

This is important for achieving effective utilization inputs in small-scale turmeric production in Benue State. This means that participation and adoption of improved turmeric production technique by producers thereby reducing technical inefficiency of turmeric production in the study area. This also means that the higher the production experience the more the producer could have gained more knowledge and technological ideas on how to tackle turmeric production problems to increase the output and income. This result is in agreement with Hossain, *et al.* (2019), who found production experience coefficient was a variable that reduced technical inefficient in turmeric production.

The coefficient of age was positive and significant at 10% level of probability. The implication is that technical inefficiency effect in small-scale turmeric production in the study area increased with increase in this variable. Older farmers are risk averse making them late adopters of better agricultural technologies. This finding is consistent with Itam_*et al*. (2015) who revealed that older farmers because of their conservative attitudes will be less willing to adopt improved technology and hence, have low levels of technical efficiency.

The coefficient of household size was positive and significant at 10% level of probability. The implication is that technical inefficiency effect in small-scale turmeric production in the study area increased with increase in this variable. Increase in family size would decrease the level of technical inefficiency if only the household is constituted of adults who make labour readily available as well as reduce the cost of hired labour. However, turmeric farmers who had large household size and are technically inefficient are those whose household were made of children which increases the farmer's cost of hired labour and hence, making the farmer more technically inefficient. This finding is at variance with Itam_*et al*. (2015) which revealed that an increase in family size would result in increased levels of technical efficiency.

Table 2: Maximum likelihood for parameters of the stochastic production frontier model for turmeric production in Benue State.

Variables	Parameters	Estimates	t-ratio
Production function			
Constant	β_0	0.375	2.457
Seed (rhizomes)	β_1	0.525	2.548***
Farm size	β_2	-0.225	-0.504
Fertilizer	β_3	0.030	0.558
Labour	β_4	-0.106	-1.244*
Inefficient model			
Constant	δ_0	-4.244	-1.244
Age	δ_1	0.216	1.714*
Sex	δ_2	-7.782	-1.308*
Education	δ_3	2.767	1.491
Farm experience	δ_4	-1.409	-1.863*
Household size	δ_5	2.443	1.598*
Membership of organization	δ_6	0.002	0.099
Sigma squared	σ^2	15.366	1.938*
Gamma	ɤ	0.97	37.188***
Log likelihood ratio		-45.388***	

Source: Field Survey (2020)

***t-ratio is significant at 1 percent level l of probability

**t-ratio is significant at 5 percent level of probability

*t –ratio is significant at 10% percent level of provability

CONCLUSION AND POLICY IMPLICATION

Evidence from the study showed that:

- Turmeric farmers in Benue state where technically efficient but there is still need for improvement since they have not attained the maximum efficiency level.
- Socio-economic characteristics of turmeric farmers such as their age, sex, farming experience, and household size significantly influenced their level of technical inefficiency in the study area.

Based on the findings from this study, the following recommendation was made:

- It was recommended that policies aimed at increasing the resource use efficiency of turmeric farmers in the State and hence their farm output can be increased by providing the turmeric farming communities with improved planting, harvesting, peeling and drying machines for higher efficiency.

REFERENCES

Amadi, C.O., Olojede, O.A., Nwokocha, C., Ironkwe, A., Ohiaeri, C.P., Amadi, G. and Uwandu, Q.C. (2018). Turmeric Research at NRCRI Umudike: Highlight of Major Achievements. *Nigerian Agricultural Journal*, 49 (1): 57-64

Chukwudi, M, Gbabo, A, and Nnaemaka, N (2019). Field Analysis of tractor-drawn Turmeric Rhizome planter. Journal of Agricultural Engineering, university of Belgrade, no. 2, pp 33-46.

Greene, W.H. (1993). The Economic Approach to Efficiency Analysis. *In* H.O. Fried, C.A.K Lovell, and S.S. Schmidt (Eds.). The Measurement of Production Efficiency. Oxford University Press, New York.

Hossain, I., Esdaile, R. J., Bell, R., Holland, C., Haque, E., Sayre, K., and Alam, M. (2009). Actual challenges: *Developing Low-Cost, No-Till Seeding Technologies for Heavy Residues; Small-Scale No-Till Seeders for Two-Wheel Tractors*. Proc Fourth World Congress on Conservation Agriculture, Delhi 4–7, 171–77.

Itam, K.O., Ajah, E.A., Ofem, U.I. and Abam, O.E. (2015). Technical Efficiency Analysis of Small Scale Cassava Farmers in Cross River State, Nigeria: A Stochastic Production Frontier Approach. *Applied Economics and Finance*, 2(4): 10-18

Jondrow, J., Lovell, C.A.K., Materov, I.S. and Schmidt, P. (1982). On Estimation of Technical Inefficiency in the Stochastic Frontier Production Function Model. *J. Econometrics* 19:233-238.

National Population Commission (NPC) (2006). Provision 2006 Nigeria Census Figures.

Olife, I.C., Onwualu, A.P., Uchegbu, K.I. and Jolaoso, M.A. (2013). Status Assessment of Spice Resources in Nigeria. *J Biol., Agric. and Health*, 3(9): 12-18